Surface Tension of Solid and Liquid Metals. Recommended Values

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The specific free surface energy, f_ω, and surface tension, σ, are important properties of interphase surface. However, these properties are not identical. The surface tension, σ, is the isochoric-isothermal work for creating unit of new surface:

$$\sigma = dA_\omega / d\omega , \qquad (1)$$

where dA_ω is the work for creating new surface $d\omega$ in the processes of homogeneous deformation or breaking of solids. The relation between σ and f_ω follows from Gibbs fundamental equation for free surface energy:

$$, \qquad (2)$$

where $F_\omega = f_\omega \omega$ is Helmholtz free surface energy.
If T=const, the latter equality becomes:

$$, \qquad (3)$$

where μ_j -chemical potential and Γ_j -adsorption of   j-th phase, ω -surface area. In the case of the one component system Γ_j =0, then (3) becomes:

$$, \qquad (4)$$

$$\left(\frac{}{d\omega} \right)_{T,V}$$

For $df_\omega / d\omega = 0$, $\sigma = f_\omega$ and in this case the quantitative identity of f_ω and σ is possible only. Surface energy (SE) and surface tension (ST) are quantitatively identical for clean one component liquid systems. During forty years in the laboratories of the physicochemical processes at the Kabardino-Balkarian State University, theoretical and experimental studies of the liquid and solid pure metals and their alloys surface properties have been carried out. In this work the results of the experimental studies of ST and its temperature coefficients for twenty clean solid metals by compensating technique of "zero-creep" method and for forty liquid metals by sessile-drop method are presented. The errors in measuring ST for solids were less than 2 p.c. and for liquids - less than 0.5 p.c.Choice of the data on the ST obtained by other researchers was made taking into consideration a safety of the used method and purity of the used metals, vacuum conditions and achievement of the thermodynamical equilibrium.Recommended values of σ and their temperature coefficients, β, of solid and liquid metals at the melting points are presented.